appeared over Newfoundland, and two, No. II and No. V, off the middle Atlantic coast. High winds occurred as follows: At 8 a. m. of 8th, as low No. III approached the New England coast, Block Island reported an east wind of 66 miles an hour. During the 13th, as No. IV moved up the Atlantic coast, Hatteras and Sandy Hook experienced north winds of 60 miles, and the same afternoon Block Island had a north wind of 72 miles, Sandy Hook northwest 60, Boston east 52, Hatteras west 50, Eastport northeast 48, and a northwest wind of 48 miles occurred at Atlantic City, Cape May, and Cape Henry; at 8 a. m. of the 26th, as No. VIII approached upper Lake region (the only severe storm of the month in the Lake region), Chicago reported a south wind of 48 miles.—*H. A. Hazen, Professor.*

RIVERS AND FLOODS.

The Mississippi River remained frozen during the entire month to below Hannibal. From the mouth of the Illinois southward, and in the Missouri east of Kansas City, the stage of water varied but slightly until the 26th and 27th when there was rise of 2 or 3 feet, owing to the heavy rains of the 25th and 26th. The Missouri also remained frozen north of Kansas City, and was likewise frozen at Kansas City from the 1st to the 17th, inclusive.

Rains on the 20th caused a rise to set in along the Ohio, but not to an alarming extent. The crest passed Pittsburg on the 23d, Wheeling on the 24th, Parkersburg on the 25th, Cincinnati on the 27th, and Louisville on the 28th.

In the lower Mississippi the crest of the January rise reached New Orleans on the 3d, but nothing of importance occurred during the month.

The heavy rains of the 3d and 4th resulted in a great rise in the Tennessee and Cumberland rivers. At Carthage, Tenn., on the Cumberland, the water rose 35.2 feet from the 3d to the 8th, reaching 41.7 feet, or 11.2 feet above the danger line. At Nashville the danger line of 40 feet was exceeded by 0.8 foot on the 11th. No losses or damage worth mentioning occurred.

In the Tennessee, however, a very different state of affairs prevailed. The rains were much heavier along this watershed and the rivers generally rose above danger lines, except at Knoxville.

The following extracts relative to this flood are taken from the special report of Mr. L. M. Pindell, Official in charge of the United States Weather Bureau office at Chattanooga, Tenn.:

Heavy rains (3d to 5th) occurred over the Tennessee River watershed, producing a sudden rise of 13 feet in twenty-four hours in the Hiawassee River; 14 feet in the Clinch River at Speers Ferry; 7 feet in the Tennessee at Knoxville, and 3.5 at Chattanooga. On the morning of the 4th the river forecast stated that the Hiawassee would rise slowly Saturday night and Sunday (4th and 5th); the Clinch would rise rapidly Saturday night and slower Sunday, and the Tennessee rapidly till Sunday morning, and slower Sunday afternoon and night, reaching about 20 feet at Chattanooga by Sunday night or Monday morning. Heavy drift began passing down by night of the 4th, with the river rising at the rate of three and one-half tenths per hour. On the morning of the 5th (Sunday), heavy rains with thunderstorms having occurred during the preceding twenty-four hours, and the river having reached the stage of 20 feet ten hours sooner than forecast, with the rise still continuing at the rate of seven and one-half tenths per hour, special reports were called for from the upper river and the following forecasts issued:

"The river (at Chattanooga) will reach 29 feet by Monday morning (actual stage reached, 29.5 feet); the crest from the Clinch will produce a second rise here, and the river will probably reach the danger line Monday night or Tuesday."

River men were notified to protect all property under the 33-foot mark.

As the rains continued, the following supplementary forecast was issued on the morning of the 6th (Monday):

"The Tennessee will continue to rise, reaching the 35-foot stage by Tuesday afternoon. From data in hand at the present time it seems probable that the crest rise will not exceed 37 feet."

On the 7th the forecast stated that the river at Chattanooga would rise steadily, reaching about 38 feet on Wednesday morning (8th). Warnings of this probable 38-foot stage at Chattanooga were also telegraphed to different points as far as Cairo.

Business men were quite uneasy about their goods in cellars, and some were advised to move their stock, which they did, and in no case was unnecessary expense incurred by the merchants. Poor people living in the lowlands consulted the office frequently. Some were advised to move, and others advised to remain and consult the office again on Wednesday morning, as ample notice and time would be given them. No one moved unnecessarily, as was proven afterward by the crest stage attained. The 3 p. m. special bulletin of the 7th showed all rivers rising except the Clinch at Clinton, Tenn., and the following forecast was issued:

"The river will continue to rise to-night, and slower Wednesday. The stage Wednesday morning will be between 37 and 38 feet. The crest rise will occur sometime between Wednesday night and Thursday morning, and will not exceed 40 feet."

The cold wave checked the rise, and at 3 p. m. of the 8th (Wednesday) advisory messages of a falling river were issued. It is estimated that the severely cold weather prevented an additional rise of at least 2 feet.

The property loss from the flood was comparatively small, and none happened that could have been avoided.

Navigation was impeded by heavy drift from the 5th to 10th, and by heavy floating ice from Knoxville to Chattanooga from the 13th to the 16th.

The forecasts were gratifyingly accurate, and the Official in charge at Chattanooga received many exceedingly commendatory notices relative to the work of the Weather Bureau. At Knoxville property to the value of $90,000 was removed and saved. The value of that saved at other places can not be estimated.

The melting of the snow and ice at the headwaters of the Tennessee produced a splendid logging stage, and about 9,500,000 feet of logs were rafted down the river by the end of the month.

At the close of the month the river was again rising on account of heavy rains, and another 20-foot stage was indicated on March 1.

The James River was also in flood from the 17th to 21st, inclusive, particularly in the vicinity of Richmond, and a detailed account by Mr. E. A. Evans, Official in charge of that station, follows:

It is probable that the history of this flood will never be written in a manner which will set forth its various phases exactly as they occurred, or without exaggeration or underestimation. The length of time during which it presented threatening conditions, as well as its rapidly changing aspects, combine to prevent full, accurate justice being done it.

On account of the unusual conditions prevailing for several days prior to the flood, it is deemed advisable, as necessary to a full understanding of subsequent events, to summarize them briefly.

From the beginning of the month the weather was stormy, days with freezing rain, sleet, and snow succeeding each other at short intervals, until the great sleet storm of the 5th to 7th, which, in its turn, was followed on the 11th by a snowstorm lasting fifty-four consecutive hours, and causing a depth on a level of 16 inches, or a total amount of unmelted precipitation on the ground at 8 p. m of the 14th of about 18 inches, inclusive of that which was in evidence prior to the beginning of the blizzard. And neither the sleet nor snow was local, but prevailed with equal energy over the entire basin of the James. At the same time the temperatures ranged unusually low for this section during the period from the 1st to the 17th, with the exception of the 4th to 8th, when they were about normal. Thus both temperature and precipitation seemed to unite to build up by degrees a situation which was pregnant with danger, and which only awaited the coming of rising temperature, thawing southerly winds, and warm rains to materialize from a possibility to an actuality; from an indicated to a present danger. These then were the conditions obtaining up to the morning of the 16th, and it is needless to say that they were regarded with increasing anxiety by this office. As early as the 12th, while the snowstorm was still raging, advisory information was sent out to the various transportation companies, steamboat lines, and individual and corporate interests liable to injury, giving the existing and expected river conditions, and suggesting that all heavy material, freight, etc., be moved to places of safety. From time to time after this date and up to the 16th additional precautionary advice along the same line was issued.

Early in the morning of the 16th, or more precisely, at 7:30 a. m., rain set in with warmer weather, and the unlocking of the frozen

streams and melting of the great mass of snow and sleet was begun. This rain continued throughout the day without intermission, and was heavier, as afterward appeared, in the upper watershed than in the vicinity of this station. Many inquiries were received during the day by telephone from interested persons, as to the probabilities of high water and to all the same information was given. "Outlook very threatening, and material liable to damage should be moved."

At 9:35 p. m. a telegram was received from the observer, Weather Bureau, Lynchburg, Va., "Rainfall one sixty." The day and night passed with gauge readings about stationary.

At 10:14 a. m. of the 17th the special river observer at Columbia, Va., telegraphed as follows: "River 21 feet, rising 8 o'clock, weather cloudy."

Here was the information long and anxiously awaited, coming from a critical point, the key to the local situation. Immediately upon its receipt telephone and messenger were put into use and flood warnings for the upper river from Norwood to Sabot issued, while locally the railroad and water transportation companies and other interests were notified as follows: "The James River will reach a 14-foot stage on the Bureau gauge by 8 p. m. and higher later."

Occasionally throughout the day advisory information was issued. A personal inspection of the river gauge at 11:30 a. m. showed no change in the height of the water as compared with the morning observation, but Superintendent W. T. West of the Southern Railway, whose bridge crosses the river at the point where the gauge is located, was seen and given verbal information of the approaching flood.

Late in the afternoon the river began to rise rapidly, bringing down masses of ice, which, lodging in the shallows at the heads of various islets with which the river is dotted, soon formed the nuclei for the gorge which developed later. Immense quantities of this ice passed under the steel bridge of the Southern Railway, and upon reaching Mayo bridge, about 200 feet below, began to gorge in the channel. This, narrow under the most favorable circumstances, soon choked with the fast accumulating pack, and damming up the waterway backed the river into the cellars and lower floors of buildings in the depressed portions of the city adjacent to the river. By 11 p. m. the gauge reading was 22 feet and the river was nearly level with the under girders of the railway bridge. Ice masses and logs scraped and ground their way under the structure only to pile up immediately below it against Mayo bridge, which at that hour seemed certain of destruction. So great was the press of the jam at this point that the superstructure was lifted and shifted from its position several inches, while heavy oaken beams and other timber work were snapped and crushed.

In the meanwhile, the south or Manchester side of the river was full of floating ice, which, lacking sufficient exit, formed a floe of large dimensions. Backwater gradually lifted it and finally started it down the stream. It passed the south end of the railway bridge without material damage, but massed against Mayo bridge and the plant of the Manchester Paper and Twine Company, doing considerable damage. A span of the bridge was badly wrecked and one of the buildings of the paper company crushed in.

Up to the hour of midnight, when the official in charge went off duty, there was practically no change in the river height, and the ice jam continued to hold the augmentation from small floes coming down from time to time. Early the following morning, 6:30 a. m., the official in charge was again on duty. At this hour the conditions were still unchanged, though less ice was then coming down. The railway officials had the previous night, after consultation with this office, run two freight trains loaded with coal upon the bridge where they remained during the acute phase of the flood. Toward noon a personal examination of the gorges in the north and south channels was made at the request of Superintendent West, who upon report, decided to use dynamite to break through the jam. During the afternoon this plan was put in operation successfully, and by 4 p. m. a free outlet was made to a point just below the Mayo bridge. This at once relieved the pent up condition of the river at and above the gauge, and subsequent readings showed first a rapid and then slow fall in the water level. It proved to be the beginning of the decline from extreme high water reading, 22 feet, but serious conditions still prevailed from below Mayo bridge to the extreme east limits of the city, to floating and wharf property, as well as residence property, in the Shockoe and Rocketts districts. Immense ice fields filled the river in all directions and were of sufficient thickness to almost entirely interrupt its outflow. Gorges were also reported at Chaffins Bluff and Dutch Gap, reliable authority, an official of the U. S. Engineer's Office, giving the former a height of 15 to 30 feet above water. Under these circumstances the subsidence of the flood was unusually slow, and it was not until the 22d that it became low enough to bring the dock again above water. This was brought about by the removal of the jam at, and below, the city.

There were some noteworthy features connected with the flood which deserve mention. First, the fact that the river at Columbia did not, at any time reach 22 feet. Under normal high water conditions this would have given not more than a 14-foot stage at this station. In this case it reached 22 feet locally, a height altogether out of proportion to its true value, and made possible only by the ice jam. Fortunately, warnings of this condition were issued. Second, regular 12-hour fluctuations in the gauge readings at Columbia, a fall and rise due to the daily melting from the Rivanna basin. The amount reaching the stream in this way took about twelve hours to move from the upper courses down to Columbia.

As to the damage done, the greatest was unavoidable; that is, to fixed objects. Much was also done which could have been avoided had the persons interested paid heed to the warnings given them. Others acted on the advice of this office and removed their material to safe places. Among these were the water transportation interests, railroads, business houses, and some individuals. One firm received the warning at 11 a. m. for a 14-foot stage at 8 p. m. They have written this office that at 7:30 p. m. the water entered their warehouse door. The intervening time had, however, been ample, and they saved a quarter of a million pounds of tobacco by intelligent use of the warning.

The damage to floating property was unusually small and in no known instance serious.

The station gauge received some damage from the ice, the full extent of which can not yet be ascertained. It is probable that a new gauge will be needed to replace it.

The North Carolina rivers also rose rapidly from the 7th to the 9th, passing the danger line of 38 feet at Fayetteville, on the Cape Fear River, on the 7th and reaching a stage of 52 feet on the 9th. The rise about the middle of the month also resulted in a stage of 43 feet on the 20th.

The rivers of South Carolina were near or above the danger lines generally from the 6th to the 10th, longer over the lower portions, and ample and accurate warnings were issued regularly after the 5th. Danger lines were again reached after the 17th, and due notice was given at the proper time. No reports of serious loss or damage were received.

The rivers of eastern Alabama were also affected by the heavy rains in early February, and flood stages resulted generally from the 4th to the 11th. Mr. F. P. Chaffee, the Official in charge at Montgomery, Ala., rendered the following special report relative to this flood:

Heavy rains over the drainage area of the Alabama and tributaries on the 3d and 4th, amounting to 2.40 inches during the twenty-four hours ending 8 a. m. of the 4th at Resaca, Ga., and 1.51 during the same time at Tallassee, Ala., started rapid rises in the upper rivers of this section. While the rivers were then at moderate stages (only about 9 feet) at Rome, Ga., and Gadsden, Ala., warnings for rapid rises were telegraphed to these two places on that date, and special reports called for from all river stations for Sunday morning (5th). These special reports showing continued rises in the upper rivers (averaging 6 feet in twenty-four hours) and the rains continuing, a supplemental warning was telegraphed to Gadsden on the 5th for flood stages at that place. Heavy rains continuing over the upper watersheds through the night of the 5th, necessitated further warning to Gadsden on the 6th, when a flood warning was also telegraphed to Wilsonville, and the river observer at Rome was notified of a probable stage of 25 feet at that place. On the 7th additional warnings were sent to Gadsden, Rome, and Wilsonville, and a warning for about a 33-foot stage was telegraphed to Selma. On the 8th the stage of 33 feet, predicted for Selma, was raised to about 36 feet.

On the 7th, warning was widely distributed by telephone and mail that stock and other property, liable to damage, should be moved from lands between Wetumpka and about 100 miles south of Selma, subject to overflow at 30 feet. During the period from 4th to 8th, warnings were also given well in advance of the rises at Wetumpka and Montgomery. All these warnings were widely distributed by telephone, through the local press, and mailed to postmasters at 25 river towns in this section.

At stations for which flood stages were predicted the water went to slightly above the danger line. In no case did the water go above the specific stage forecasted, while the greatest deviation from the stage forecasted was at Selma, where it reached 34.4 feet, or 1.6 foot less than the stage specified.

The fact that the warnings were so well in advance of the high waters, and were so approximately correct, has, it is thought, been the means of maintaining public confidence in this branch of the Bureau's work in this section. While flood stages were attained only from about Wilsonville to Gadsden, still the expense of telegraphing rapid-rise warnings to other points was justified, from the fact that much stock is wintered in the canebrakes of the low grounds of this section, which were all submerged. It is known that the warnings were the means of saving a large number of cattle, which otherwise would have been drowned; the warnings were of special value to the lumber interests of the Coosa River, and were of great use to the railroads in protecting their roadbeds.

High stages also prevailed generally throughout the month in the rivers of western Alabama, the lowest stage at Demopolis for the month having been 25.9 feet on the first day.

A stage of 47.9 feet, 12.9 feet above the danger line, was reached on the 15th, falling to 31.2 feet by the 26th, when another sharp rise set in, continuing at the close of the month. Warnings were issued when necessary, and no damage of consequence resulted.

Nothing of importance occurred along the rivers of the Pacific coast, although the Willamette was above the danger line at Eugene, Oreg., on the 9th and 10th.

ICE IN RIVERS AND HARBORS.

There was ice, either floating or solid, throughout the entire Mississippi watershed. It became solid as far south as Cairo by the 7th, and remained so until the 21st, when it commenced to move. At Chester the gorge broke on the 19th; at St. Louis on the 22d, and at Grafton, Ill., on the 27th. After these dates floating ice, gradually decreasing in quantity, was present until the end of the month.

East of Kansas City the Missouri was practically gorged from the 1st to the 22d, although not actually so east of Hermann, Mo., until the 6th. At St. Louis the ice gorged both above and below the city on the 8th, and on the 9th only a ferryboat channel remained. On the 11th the ice was sufficiently strong for pedestrians and skaters, and on the 12th was from 12 to 16 inches in thickness. The ferryboat channel was opened by tugs on the 17th, and on the 18th the ice was slowly breaking. It began to move on the 20th, and on the 22d moved out with little damage.

At Cairo the Mississippi froze back of the city on the 5th, and railroad ferryboats were working night and day to keep navigation open at the mouth of the Ohio. By the 7th the ice had become solid, and navigation was suspended, not to be resumed until the 22d. On the 13th it was 13 inches thick.

In the Ohio there was ice in greater or less quantities during the major portion of the month, and navigation was suspended from two to ten days at various places. The Allegheny and Monongahela were practically frozen until the 20th. At Freeport, Pa., on the Allegheny River, when the gorge moved out, it carried with it two spans of the Allegheny Valley Railroad bridge.

There was also heavy floating ice in the Tennessee and Cumberland rivers from the 13th until about the 18th.

In the lower Mississippi ice was first observed at Memphis and Helena on the 8th, and navigation was suspended at Memphis on the 10th. On the 14th heavy ice damaged some of the boats in the harbor, and two of them sank. The ice reached Greenville, Miss., on the 11th, and Vicksburg on 12th. From the 13th to the 16th it was very heavy at the latter place, much more so than had ever before been observed. It gorged on the 13th one mile above the city in the main channel, and navigation was suspended. New Orleans was reached on the 17th, and on the 19th floating ice was passing out into the Gulf of Mexico. It ceased at New Orleans on the 20th.

South of Cairo navigation was resumed as follows: at Memphis on the 18th, and at Vicksburg on the 17th.

The Arkansas River was frozen over at Fort Smith from the 11th to the 16th, inclusive, and was free from ice on the 17th. At Little Rock the conditions were, as a whole, unprecedented, and are well described in the following report by Mr. E. B. Richards, the Official in charge of that station:

> The extreme cold which swept over the State, like a breath from the frozen pole, from the 8th to, and including, the 16th, broke all records both as to the minimum temperature and the protracted character of the cold spell. Only once "within the memory of the oldest inhabitant" was it equaled, and that was in "the winter of '63, when the Union forces hauled their cannon across the Arkansas River on the ice," and only once since the establishment of the Weather Bureau in this city was the river frozen over for a greater length of time. The records show but two previous occasions when the river was frozen over. On February 3, 1886, it was frozen over from shore to shore; in February, 1895, it was again frozen from shore to shore from the 7th to the 17th, both dates included.
>
> Floating ice was first observed on the morning of February 7. On the 8th the ice became gorged, about a mile east of the city, about 10 a. m. On the morning of the 9th the river was frozen solid from bank to bank, and continued in this condition until about 9 a. m. of the 17th, when the ice began to break and pass out. Floating ice continued during the 18th and 19th, entirely disappearing on the last-mentioned date. On the 13th the thickness of the ice was 5 inches.

At Newport, Ark., on the White River, there was floating ice from the 8th to the 11th, and a gorge from the 12th to the 16th, inclusive.

In the Atchafalaya River ice from 8 to 14 inches in thickness was running at Melville, La., from 16th to 20th, inclusive.

In the rivers of the East there was ice as far south as Camden, S. C., on the Wateree River, where there was ice and snow on the 13th. At Cheraw, S. C., the Pedee was full of ice on the 16th and 17th.

Thickness of ice in rivers (in inches), winter of 1898–99.

Stations.	December.				January.					February.				March.				April.	
	5.	12.	19.	26.	2.	9.	16.	23.	30.	6.	13.	20.	27.	7.	14.	31.	28.	4.	11.
Moorhead, Minn	13.5	15.0	18.0	20.0	24.0	26.0	26.0	26.0	26.0	32.0	38.0	42.0	43.0	.....	.....	.....	.....	.....	.....
St. Paul, Minn	10.0	14.0	16.0	18.0	22.0	23.5	22.5	22.5	24.5	28.0	30.0	25.0	23.0	.....	.....	.....	.....	.....	.....
La Crosse, Wis	6.5	*	13.0	14.0	15.0	20.0	22.0	19.0	26.0	27.0	32.0	22.0	20.0	.....	.....	.....	.....	.....	.....
Dubuque, Iowa	8.0	10.0	11.0	10.0	14.0	15.0	13.0	10.0	18.0	20.0	27.5	22.0	18.0	.....	.....	.....	.....	.....	.....
Davenport, Iowa	.....	1.0	11.0	11.0	12.5	14.0	13.0	12.0	14.0	14.5	21.5	21.5	21.0	.....	.....	.....	.....	.....	.....
Keokuk, Iowa	.....	7.0	8.5	10.0	14.0	13.0	12.0	11.0	13.0	15.0	26.0	15.0	10.0	.....	.....	.....	.....	.....	.....
Hannibal, Mo	.....	7.0	9.0	6.0	*	11.0	.....	.....	5.0	11.0	16.0	10.0	9.0	.....	.....	.....	.....	.....	.....
Williston, N. Dak	12.0	12.0	12.0	12.0	16.0	18.0	20.0	20.0	21.0	32.0	32.0	32.0	32.0	.....	.....	.....	.....	.....	.....
Bismarck, N. Dak	10.0	16.0	18.0	18.0	20.0	20.0	24.0	24.0	*	27.0	34.0	30.0	30.0	.....	.....	.....	.....	.....	.....
Pierre, S. Dak	11.0	14.0	14.5	15.0	17.0	19.5	19.0	17.5	20.0	23.0	25.0	18.0	14.0	.....	.....	.....	.....	.....	.....
Yankton, S Dak	8.0	11.5	15.5	15.5	16.0	16.0	16.0	16.0	18.5	21.5	26.0	25.0	25.0	.....	.....	.....	.....	.....	.....
Sioux City, Iowa	8.5	12.0	12.0	11.0	15.0	16.5	17.5	16.5	18.0	21.0	24.0	17.0	19.0	.....	.....	.....	.....	.....	.....
Omaha, Nebr	6.0	8.0	10.0	10.0	*	12.0	*	6.0	10.0	14.0	22.0	20.0	20.0	.....	.....	.....	.....	.....	.....
Topeka, Kans	....	2.5	3.0	2.5	4.0	.....	.....	.....	3.5	11.0	15.0	4.0	6.0	.....	.....	.....	.....	.....	.....
Kansas City, Mo	.....	.....	.....	.....	.....	.....	.....	.....	3.0	8.0	13.0	.....	.....	.....	.....	.....	.....	.....	.....
Wichita, Kans	.....	3.0	.....	.....	.....	.....	.....	.....	4.0	.....	12.0	.....	.....	.....	.....	.....	.....	.....	.....
Pittsburg, Pa	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.4	.....	.....	.....	.....	.....	.....	.....	.....
Parkersburg, W. Va	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.0	.....	.....	.....	.....	.....	.....	.....	.....
Columbus, Ohio	.....	8.0	8.0	5.0	0.5	2.5	.....	.....	4.0	6.0	8.0	6.0	.....	.....	.....	.....	.....	.....	.....
Memphis, Tenn	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.5	1.0	.....	.....	.....	.....	.....	.....	.....	.....
Fort Smith, Ark	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.0	.....	.....	.....	.....	.....	.....	.....	.....
Little Rock, Ark	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.0	.....	.....	.....	.....	.....	.....	.....	.....
New Orleans, La	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.0	.....	.....	.....	.....	.....	.....	.....	.....
Brattleboro, Vt	2.0	2.5	6.5	*	8.0	10.0	9.0	11.0	13.0	17.0	18.5	18.0	17.5	.....	.....	.....	.....	.....	.....
Concord, Mass	2.0	3.0	*	*	11.0	*	*	12.0	15.0	16.0	*	22.0	17.0	.....	.....	.....	.....	.....	.....
Albany, N. Y	.....	.....	5.0	3.0	6.5	1.0	6.0	8.0	10.0	9.5	11.0	9.0	8.5	.....	.....	.....	.....	.....	.....
New Brunswick, N. J	.....	.....	.....	.....	1.5	.....	.....	.....	.....	5.0	8.0	13.0	.....	.....	.....	.....	.....	.....	.....
Harrisburg, Pa	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.0	12.0	.....	.....	.....	.....	.....	.....	.....
Lynchburg, Va	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.0	.....	.....	.....	.....	.....	.....	.....	.....
Richmond, Va	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.0	2.0	.....	.....	.....	.....	.....	.....	.....
Columbia, S. C	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.0	.....	....	.....	.....	.....	.....	.....	.....

* Missing.

The James at Richmond was gorged from the 13th to the 21st, inclusive, and the Potomac at Harpers Ferry from the 10th to the 21st, inclusive.

At Williamsport, Pa., the Susquehanna was frozen over from the 7th to the 22d, inclusive, the ice going out below the dam on the 23d. At Harrisburg the river was closed from the 9th until the 23d, when the ice went out gradually without causing any damage.

At Albany, N. Y., the ice harvest ceased by the end of the month. All was cut that could be handled, and the crop was unexcelled both as to quality and quantity.

Considerable inconvenience was also caused by the ice in the Columbia River on the north Pacific coast. At Umatilla there was floating ice from the 1st until the 15th, and at The Dalles navigation was suspended on the 3d by ice, which blocked the river until the 16th. Navigation was resumed on the 17th, and by the 19th the river was clear of ice. At Portland there was much floating ice in the Columbia on the 4th, and on the 5th navigation above the mouth of the Willamette was suspended owing to ice. The Willamette was frozen over a short distance above the railroad bridge on the 5th and 6th, but not enough to impede navigation. The ice began to break in the Columbia on the 8th, and on the 9th it had also disappeared from the Upper Willamette. On the 14th boats were again running on the Columbia, although there was still considerable ice.

The intensification of the winter conditions and their unprecedented extension southward to the Gulf of Mexico can be seen in the preceding table, which shows the thickness of the ice in the rivers for each week since December 5, 1898.

On February 6 there was ½ inch of ice at Memphis; by the 13th this had increased to 1 inch and had extended to New Orleans, where there were 2 inches, a record unparalleled in the history of the city, as far as is known.

At Moorhead, on the Red River of the North, there was an increase during the month of 14 inches, from 28 to 42 inches. In the Upper Mississippi there was a gradual decrease in the amount except at Davenport and Hannibal, where there were increases of 7 and 4 inches, respectively. In the Missouri the changes were irregular, but, as a whole, there was more ice at the close of the month, except at Pierre, where there was a loss of 6 inches. The greatest thickness in the Missouri was found at Williston, where it was 32 inches, while at Omaha there were 20 inches.

The highest and lowest water, mean stage, and monthly range at 115 river stations are given in the accompanying table. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are: St. Louis, Cairo, Memphis, and Vicksburg, on the Mississippi; Cincinnati, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Forecast Official.*

Heights of rivers referred to zeros of gauges, February, 1899.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn	1,957	14	Frozen					
Reads Landing, Minn	1,887	12	— 0.4	1,21-24,28	—0.6	8-13,15-19	—0.5	— 1.0
La Crosse, Wis	1,822	12	Frozen					
North McGregor, Iowa	1,762	18	3.6	28	1.0	1, 13, 14	1.9	2.6
Dubuque, Iowa	1,702	15	Frozen					
Leclaire, Iowa	1,612	10						
Davenport, Iowa	1,596	15	Frozen					
Galland, Iowa	1,475	8	Frozen					
Keokuk, Iowa	1,466	14	Frozen					
Hannibal, Mo	1,405	17	Frozen					
Grafton, Ill	1,307	23	10.2	28	2.9	2	4.6	7.3
St. Louis, Mo	1,264	30	13.6	28	— 0.7	1	5.0	14.3
Chester, Ill.[1]	1,189	36	8.8	26	—1.3	2	2.8	10.1
Cairo, Ill	1,073	45	38.9	15	20.2	6	27.7	13.7
Memphis, Tenn	843	33	24.3	1	14.0	7,8	19.8	10.3

Heights of rivers referred to zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River—Con.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Helena, Ark	767	42	36.1	1	22.6	10	29.3	13.5
Arkansas City, Ark	695	42	40.2	1	28.0	12	32.9	12.2
Greenville, Miss	595	42	34.6	1	23.4	12	27.9	11.2
Vicksburg, Miss	474	45	39.6	1,2	28.5	14	33.4	11.1
New Orleans, La	108	16	14.3	3,7,8	11.5	19	13.0	2.8
Arkansas River.								
Wichita, Kans	720	10	1.9	9	1.4	28	1.6	0.5
Fort Smith, Ark.[2]	345	22	10.9	28	3.0	10	4.5	7.9
Dardanelle, Ark.[3]	250	21	4.8	28	2.1	9-11	3.1	2.7
Little Rock, Ark.[4]	170	23	7.5	28	4.0	18	4.9	3.5
White River.								
Newport, Ark	150	26	15.7	28	3.4	15	6.8	12.3
Des Moines River.								
Des Moines, Iowa	150	19	Frozen					
Illinois River.								
Peoria, Ill	135	14	10.6	28	5.3	19-21	6.9	5.3
Missouri River.								
Bismarck, N. Dak	1,201	14	4.6	9-11	3.7	22, 23	4.2	0.9
Pierre, S. Dak	1,006	14	Frozen					
Sioux City, Iowa	676	19	Frozen					
Omaha, Nebr	561	18	Frozen					
St. Joseph, Mo	373	10	2.9	9	0.7	1,2	1.8	2.0
Kansas City, Mo.[5]	280	21	7.7	27,28	7.0	18	7.4	0.7
Boonville, Mo	191	20	12.2	27	4.2	4	6.7	8.0
Hermann, Mo.[6]	95	24	10.5	27	1.6	3	4.9	8.9
Ohio River.								
Pittsburg, Pa	966	22	14.7	23	2.3	3, 12, 16	6.7	12.4
Davis Island Dam, Pa	960	25	14.1	23	9.2	7	7.9	4.9
Wheeling, W. Va.[7]	875	36	20.6	24	5.1	3	11.7	15.5
Parkersburg, W. Va.[1]	785	36	20.9	25	6.0	14	12.3	14.9
Point Pleasant, W. Va	703	39	27.9	24	6.0	16	16.8	21.9
Catlettsburg, Ky	651	50	36.0	8	7.5	17	23.2	28.5
Portsmouth, Ohio	612	50	36.5	8	8.7	17	23.4	27.8
Cincinnati, Ohio	499	50	39.4	27	11.5	18	25.9	27.9
Louisville, Ky	367	28	15.9	28	6.8	18	10.7	9.1
Evansville, Ind	184	35	33.0	28	13.8	19	23.3	19.2
Paducah, Ky	47	40	33.0	14	19.5	5,6	26.1	13.5
Allegheny River.								
Warren, Pa	177	7	4.1	24	0.8	10, 14, 19	1.6	3.3
Oil City, Pa	123	13	6.2	23	1.3	13-16	2.2	4.9
Parkers Landing, Pa.[13]	73	20	5.6	28	1.2	9	1.5	4.4
Freeport, Pa	26	20	13.0	22	1.3	14-17	5.3	11.7
Conemaugh River.								
Johnstown, Pa.[8]	64	7	5.2	22	2.0	10	3.0	3.2
Red Bank Creek.								
Brookville, Pa	35	8	1.9	22	0.7	1-21	0.8	1.2
Beaver River.								
Ellwood Junction, Pa.	10	14	6.5	23	1.3	3	2.1	5.2
Cumberland River.								
Burnside, Ky	434	50	45.6	6	4.9	2, 16	16.3	40.7
Carthage, Tenn	257	30	41.7	8	6.0	16	19.3	35.7
Nashville, Tenn	175	40	40.8	11	10.5	3	24.5	30.3
Great Kanawha River.								
Charleston, W. Va	61	30	19.9	6	4.6	3	9.7	15.3
New River.								
Hinton, W. Va	95	14	9.0	6,7	2.0	15	4.8	7.0
Licking River.								
Falmouth, Ky.[9]	30	25	11.5	6	4.5	2	8.5	7.0
Miami River.								
Dayton, Ohio	69	18	5.5	27	1.9	6,7	2.7	3.6
Monongahela River.								
Weston, W. Va	161	18	7.5	4	0.0	2, 15	1.8	7.5
Fairmont, W. Va	119	25	13.5	4	1.7	2,3	5.3	11.8
Greensboro, Pa.[10]	81	18	16.0	5	7.5	2,3	10.1	8.5
Lock No. 4, Pa	40	28	22.0	5	8.0	2, 12-16	12.0	14.0
Cheat River.								
Rowlesburg, W. Va.[11]	36	14	9.0	4	4.0	26	5.5	5.0
Youghiogheny River.								
Confluence, Pa	59	10	7.5	27	1.6	15, 16	3.8	5.9
West Newton, Pa.[15]	15	23	11.0	4	3.0	9	3.0	8.0
Muskingum River.								
Zanesville, Ohio	70	20	14.7	28	7.0	3	9.7	7.7
Tennessee River.								
Knoxville, Tenn			23.1	7	0.6	1,2	6.6	22.5
Kingston, Tenn	534	25	26.1	8	2.4	2,3	9.3	23.7
Chattanooga, Tenn[1]	430	33	38.2	9	5.4	3	16.2	32.8
Bridgeport, Ala	390	24	26.7	10	3.9	1	12.5	22.8
Florence, Ala	220	16	20.5	14	4.5	1	12.8	16.0
Johnsonville, Tenn	94	21	29.6	17	7.7	2	20.9	21.9
Clinch River.								
Speers Ferry, Va	156	20	16.0	6	0.3	1,2	4.2	15.7
Clinton, Tenn	46	25	28.0	6,7	5.3	2	13.0	22.7
Wabash River.								
Mount Carmel, Ill.[12]	50	15	15.2	28	5.5	22, 23	9.0	9.7
Red River.								
Arthur City, Tex	688	27						
Fulton, Ark	565	28	5.8	1	3.0	15	4.2	2.8
Shreveport, La	449	29	11.5	1	3.8	27	6.5	7.7
Alexandria, La	139	33	16.8	1	7.2	26	10.7	9.6
Atchafalaya Bayou.								
Melville, La	100*	31	31.2	2-6	28.2	17	29.6	3.0
Ouachita River.								
Camden, Ark	340	39	14.8	28	7.0	18	9.7	7.8
Monroe, La	100	40	32.3	5	25.0	28	29.6	7.3
Yazoo River.								
Yazoo City, Miss	80	25	20.0	6,7	17.3	15, 16, 25	18.5	2.7
Flint River.								
Albany, Ga	80	20	21.8	15	8.3	1	13.7	13.5
Cape Fear River.								
Fayetteville, N. C.	100	38	52.0	9	10.0	15	27.7	42.0
Columbia River.								
Umatilla, Oreg	270	25	4.1	22	0.8	13	2.3	3.3
The Dalles, Oreg	166	40	7.0	23	2.2	9	5.2	4.8

Heights of rivers referred to zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Willamette River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Albany, Oreg	99	20	18.4	11	4.1	7	8.6	14.3
Portland, Oreg	10	15	11.7	12	2.4	6	6.8	9.3
Edisto River.								
Edisto, S. C	75	6	6.5	13	5.0	1,2	5.8	1.5
James River.								
Lynchburg, Va.[8]	257	18	7.5	28	1.3	2,3	4.2	6.2
Richmond, Va	110	12	22.0	18	0.2	1	6.6	21.8
Alabama River.								
Montgomery, Ala	265	35	38.0	28	13.0	1	21.2	20.0
Selma, Ala	212	35	34.4	11	10.8	1	24.6	23.6
Coosa River.								
Rome, Ga	225	30	24.0	8	5.0	14,15	11.7	19.0
Gadsden, Ala	144	18	21.5	8	6.7	1,16	13.4	14.8
Tombigbee River.								
Columbus, Miss	285	33	21.0	8	3.8	1	9.9	17.2
Demopolis, Ala	155	35	47.9	15	25.9	1	39.4	22.0
Black Warrior River.								
Tuscaloosa, Ala	90	38	51.7	8	18.5	22,26	29.9	33.2
Pedee River.								
Cheraw, S. C	145	27	34.9	8	5.5	15	18.4	29.4
Black River.								
Kingstree, S. C	60	12	11.6	19-21	8.8	4.5	10.3	2.8
Lumber River.								
Fairbluff, N. C	10	6	7.5	15	4.9	1,3	6.6	2.6
Lynch Creek.								
Effingham, S. C	35	12	17.2	13	8.6	1,2	12.8	8.6
Potomac River.								
Harpers Ferry, W. Va	170	16	13.6	23	2.6	5-14	5.3	11.0

Heights of rivers referred to zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Roanoke River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Clarksville, Va	155	12	9.9	7	2.0	1	5.8	7.9
Sacramento River.								
Red Bluff, Cal	241	23	4.1	21,22	0.6	10	2.5	3.5
Sacramento, Cal	70	25	14.1	1	11.6	15-19	13.3	2.5
Santee River.								
St. Stephens, S. C	50	12	15.3	15	8.0	3-8	10.4	7.3
Congaree River.								
Columbia, S. C	37	15	21.3	8	1.8	4	7.6	19.5
Wateree River.								
Camden, S. C	45	24	31.0	8	8.0	4	17.5	23.0
Savannah River.								
Augusta, Ga	130	32	30.9	8	11.5	26	17.8	19.4
Susquehanna River.								
Wilkesbarre, Pa	178	14	12.0	24	5.2	20,21	7.5	6.8
Harrisburg, Pa	70	17	9.0	28	1.9	3	4.6	7.1
Juniata River.								
Huntingdon, Pa[14]	80	24	7.0	27	4.3	21,22	5.1	2.7
W. Br. of Susquehanna.								
Williamsport, Pa	35	20	8.3	28	2.3	14,15	3.6	6.0
Waccamaw River.								
Conway, S. C	40	7	8.4	28	4.9	5-7	6.3	3.5

[8] Distance to Gulf of Mexico. [1] Record for 27 days. [2] Record for 22 days. [3] Record for 24 days. [4] Record for 19 days. [5] Record for 11 days. [6] Record for 12 days. [7] Record for 25 days. [8] Record for 20 days. [9] Record for 21 days. [10] Record for 26 days. [11] Record for 13 days. [12] Record for 7 days. [13] Record for 16 days. [14] Record for 8 days. [15] Record for 14 days.

THE WEATHER OF THE MONTH.

By ALFRED J. HENRY, Chief of Division of Records and Meteorological Data.

The overshadowing event of the month was the severe and widespread cold lasting from January 26 to February 14, and culminating in a freeze that for duration and severity stands unparalleled in the history of the Weather Bureau.

Strictly speaking, there were at least two, possibly three, separate and distinct cold waves, each of which followed a course somewhat different from that of the others. The cold was doubtless greatly intensified by the snow covering of the northeastern Rocky Mountain slope and other regions to the eastward.

As stated in the January MONTHLY WEATHER REVIEW, page 5, a succession of snowstorms, accompanied by high winds, swept southeastward from the Northwest Territories during the closing days of January, carrying the snow covering to northern Texas, and cold weather to the Gulf and Atlantic coasts. During this period the Rocky Mountains seemed to act as an effective barrier to the movement of cold air westward over the Plateau region. On February 1, however, a low moved inland from the Pacific, striking the continent about latitude 45°, and moving thence southeastward over the Great Basin and around southern New Mexico to southwest Texas. The passage of this low into the interior appears to have been the key move to the changes that rapidly followed.

Close upon the retreating low an area of high pressure and cold weather advanced from Alberta, crossing to the western side of the Rocky Mountains and settling over the northern Plateau, where it remained almost stationary until the 7th. The temperature fell throughout the Plateau region and on the Pacific coast on the 3d, 4th, 5th, and 6th, the lowest points reached being within a degree or so of the lowest temperatures previously recorded. The minimum temperature at San Diego was 33.5°, lowest previous minimum 32°, while at Cuyamaca Dam, only 60 miles distant, but in the mountains, the temperature fell to 5° below zero. Heavy snows fell in the middle Plateau and Rocky Mountain regions on the 7th, thus reinforcing the heavy covering of snow already upon the ground.

A second high appeared over Assiniboia on the 7th, moving southeastward and the plateau high began an eastward movement, uniting with it on the 8th. This second high, however, apparently remained stationary north of Montana from the 8th to the 11th; pressure gradually increased until the morning of the last-named date, when a maximum of 31.42 inches was reached at Swift Current. In the mean time an offshoot had moved southeastward over the upper Mississippi Valley, the Ohio Valley, the lower lakes, and the Middle Atlantic States, reaching the Atlantic coast in the vicinity of Chesapeake Bay on the morning of the 11th and causing extremely low temperatures in its course, in many cases the lowest recorded in the last twenty-eight years.

On the morning of the 11th, the high which had been apparently stationary over Assiniboia for three days began its southeastward movement, reaching the Texas coast by 10:00 a. m. of the 12th as a violent norther, with temperature 3° lower than ever before recorded. Moving rapidly eastward, it passed successively over the Gulf States, reaching the Florida Peninsula by the morning of the 13th, and thence northeastward along the Atlantic coast, but after reaching Virginia the minimum temperatures were not so low as those of the 10th, 11th, and 12th. We have thus seen that there were three separate and distinct periods of cold and that all sections of the country were visited, except Arizona and a portion of New Mexico on the southwest and portions of the Lake region and New England on the northeast.

The minimum temperatures recorded in the several States and Territories are shown in Tables I and II and graphically on Chart VI. A word of explanation in regard to minimum temperatures registered at Weather Bureau stations in large cities may be appropriate. Generally, Weather Bureau thermometers are installed at a height of 10 to 15 feet above the roofs of high buildings; rarely over sod at an elevation of from 10 to 20 feet above ground. When there is little or no movement of wind, especially at night, the colder air settles in the lowlands and valleys. It may easily happen in such cases that a thermometer on the top of a high building is entirely above the layer of cold air near the surface of the ground.

Thermometers exposed on the tops of buildings in large